Colorado-Lower Gila Watershed

COLORADO-LOWER GILA WATERSHED CHARACTERISTICS

SIZE	14,459 square miles (13% of the State's land area).
POPULATION BASE	Approximately 285,500 people live in this watershed (estimated from the 2000 census). This is about 5% of the state's population.
LAND OWNERSHIP **(Figure 15)**	Bureau of Land Management 33%; Military reservations 25%; Other state and federal land 17%; National Wildlife Refuge 14%; State Land Dept. 6%; Tribal land 4%; Private <1%
LAND USES AND PERMITS **(Figure 16)**	Major communities in this watershed include: Yuma, Bullhead City, and Lake Havasu City. Tribal and private land along the lower Colorado River and lower Gila River is intensively cultivated. Open grazing occurs across the watershed. This watershed contains major military ranges with live fire exercise areas (bombing ranges). Six wildlife refuges and three wilderness areas have been established in this watershed. Land uses within these designated areas are restricted (i.e., mineral lease and mineral entry withdrawn and motorized travel prohibited); however, grazing still occurs on most of these lands.
HYDROLOGY AND GEOLOGY	This watershed is defined by the Colorado River drainage area within Arizona below Lake Mead to the border with Mexico, excluding the Bill Williams River and the Gila River above Painted Rocks dam. Perennial water is primarily limited to the main stem of the Colorado River, with irrigation return flow providing perennial flow in the Gila River near its confluence with the Colorado River (Brown et al. 1978). Above Imperial Dam diversions, the flow on the Colorado River has varied between a minimum of 1,450 cfs to a maximum of 40,800 cfs since Hoover Dam was constructed in 1935 (USGS 1996). Several ground water basins are included in this large watershed, including: Butler Valley, Hualapai Valley, Lower Gila, Lake Havasu, Lake Mohave, Parker, Ranegras Plain, Sacramento Valley and Yuma basins, with a small portion of the Harquahala basin. Ground water in valleys is typically found in unconfined high yield aquifers consisting of basin-fill sediments, alluvial sands, and gravel. Confined aquifers are often found in Bouse formations and fanglomerate units (ADWR 1994). This watershed is within the Basin and Range Hydrologic Province, which is characterized by fault-block desert mountains with broad valleys and basins. Elevations in the watershed range from 80 feet above sea level where the Colorado River enters Mexico to 5456 feet above sea level in the Black Mountains near Lake Mohave.
UNIQUE WATERS	None
ECOREGIONS	Southern Basin and Range.
OTHER STATES, NATIONS, TRIBES	This watershed receives drainage from the Colorado River, the Bill Williams River, and the Gila River. At Yuma, the Colorado River receives drainage from Utah, Colorado, Wyoming, New Mexico, Nevada, California, and Arizona. Fort Mohave, Fort Yuma, Cocopah, and Colorado River tribal lands occur within this watershed. Although these lands occupy only 4% of the land, they are primarily adjacent to the Colorado River.

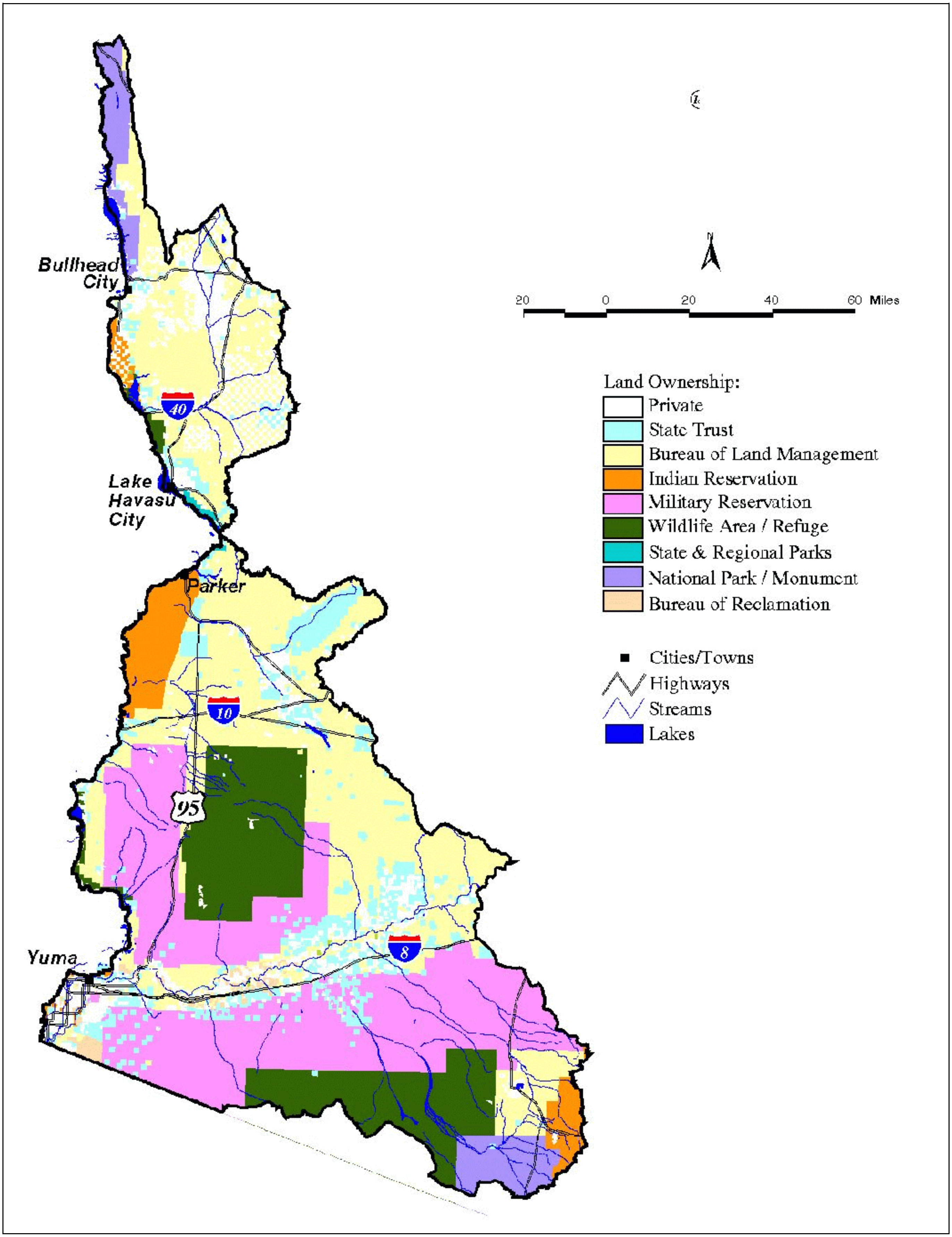

Figure 15. Land Ownership in the Colorado-Lower Gila Watershed

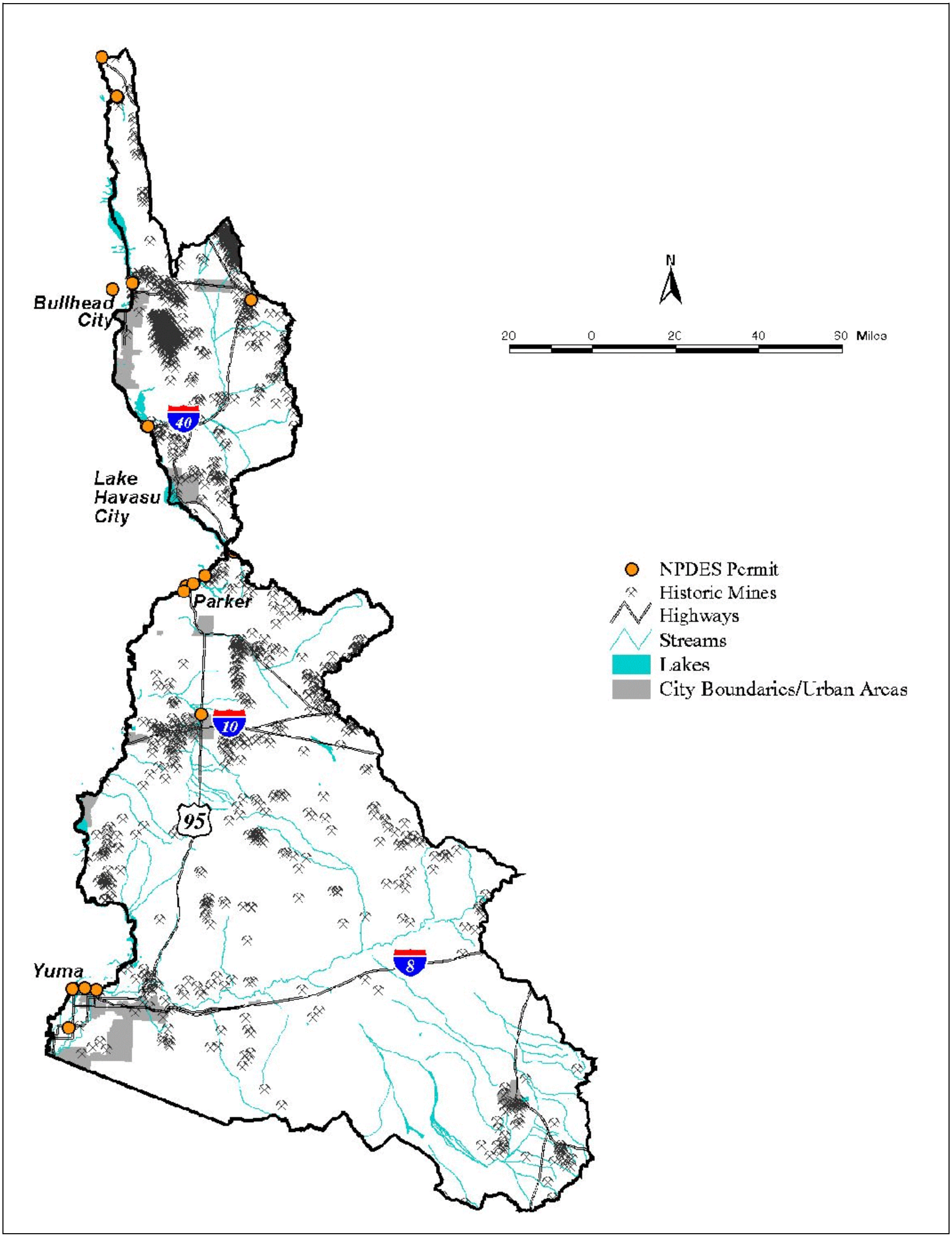

Figure 16. General Land Use and NPDES Permits in the Colorado-Lower Gila Watershed

Colorado-Lower Gila Watershed Assessment Discussion

Statistical Summary of Surface Water Assessments

Assessments – For the 2002 assessment, 132 stream miles and 29,156 lake acres were assessed. Fewer assessments were completed than previously because of two factors: 1) changes in assessment criteria requiring more data to base an assessment, and 2) a lack of current credible data. This watershed will be a focus for water quality monitoring in 2003.

Water quality assessment information for the Colorado-Lower Gila Watershed is summarized in the following tables and illustrated on **Figure 17**.

Table 9. Assessments in the Colorado-Lower Gila Watershed – 2002

	STREAMS		LAKES	
	miles	number of segments	acres	number of lakes
ATTAINING	132	5	16,120	1
INCONCLUSIVE	0	0	12,850	1
IMPAIRED	0	0	186	1
NOT ATTAINING	0	0		
TOTAL ASSESSED	132	5	29,156	3

PERENNIAL SURFACE WATERS ASSESSED		STREAMS		LAKES	
		miles	number of segments	acres	number of lakes
	Assessed	132	5	29,156	3

* Note that streams with significant perennial stretches within the reach assessed were included in the perennial milage although part of the reach may have ephemeral or intermittent flow.

Inconclusive Assessments – As shown in the following monitoring table, all reaches in this watershed were assessed as "attaining," however, some of the designated uses were assessed as "inconclusive." All surface waters with a designated use assessed as "inconclusive" were added to the new Planning List. By the end of the focused watershed monitoring (scheduled in 2003), ADEQ expects to monitor most of these reaches so that all designated uses can be assessed during the following assessment cycle. Other lakes and streams which lack monitoring data will also be monitored depending on resources and priorities.

ADEQ will be coordinating with the USGS and the Bureau of Reclamation, which collect monitoring data on the Colorado River, reservoirs, and back waters, so that future monitoring efforts will better support Arizona's surface quality water assessments.

Major Stressors – When a surface water is listed as impaired, the pollutants or suspected pollutants causing the impairment are identified. Only one lake is to be listed as impaired in this watershed: Painted Rocks Borrow Pit Lake. This lake is impaired due to low dissolved oxygen and high fecal coliform.

An investigation is needed to determine whether the low dissolved oxygen is due to pollutants or is due to natural drying conditions at the lake. ADEQ has adopted new surface water standards that replace the fecal coliform standard with an Escherichia coli standard. These new standards still need to be approved by EPA. If adopted they would bring this lake into compliance with bacterial standards as Escherichia coli standards are being met.

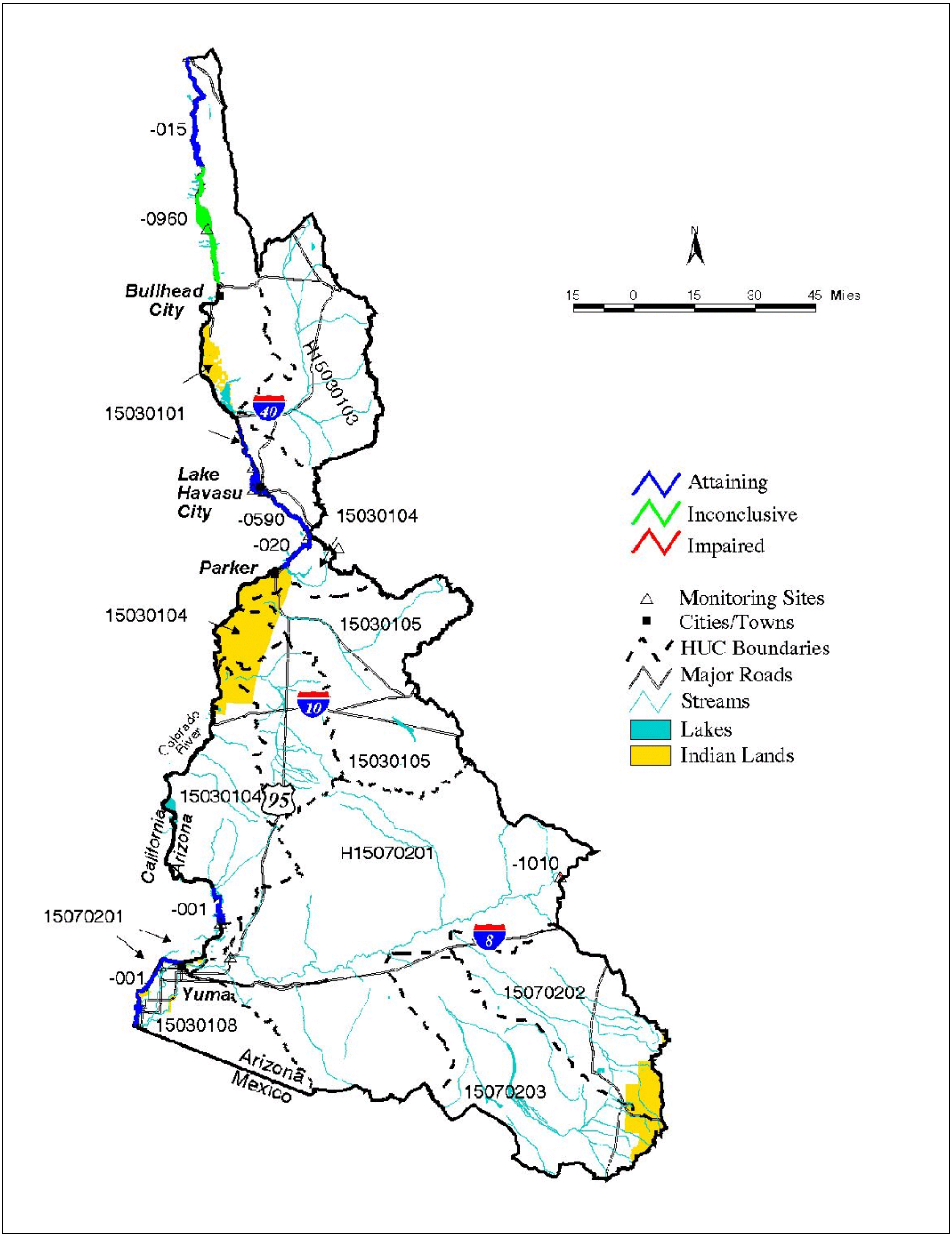

Figure 17. Colorado-Lower Gila Watershed Surface Water Assessments – 2002

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA

STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED NUMBER AND TYPE OF SAMPLES	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATED USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
STREAM MONITORING DATA								
Colorado River Hoover Dam-Lake Mohave AZ15030101-015 A&Wc, FC, FBC, DWS, AgI, AgL	USGS Station 09421500 At Hoover Dam CMCLR243.26	1996 - 11 suites 1997 - 6 suites 1998 - 6 suites 1999 - 6 suites	Dissolved oxygen mg/L	7.0 90% saturation (A&Wc)	6.1-10.4 56-101% saturation	3 of 29		Naturally occurring low dissolved oxygen caused by water release at dam is from lake bottom. (Not included in the final assessment.) Missing core parameters: total mercury, arsenic, beryllium, barium, fluoride, copper, manganese, and Escherichia coli.
	Reach Summary Row **A&Ww Attaining** **FC Inconclusive** **FBC Inconclusive** **DWS Inconclusive** **AgI Inconclusive** **AgL Inconclusive**	**1996-2000** **29 sampling events** **Missing core parameters**	**OK**				**Attaining**	**US Geological Survey collected 29 samples in1996-1999. Reach assessed as "attaining some uses"and was placed on the Planning List due to missing core parameters.**
Colorado River Bill Williams R.-Osborne AZ15030104-020 A&Ww, FC, FBC, DWS, AgI, AgL	USGS Station 09427520 Below Parker Dam CMCLR127.02	1996 - 6 suites 1997 - 6 suites 1998 - 6 suites 1999 - 2 suites, 1 field 2000 - 4 suites	OK					
	Reach Summary Row **A&Ww Attaining** **FC Attaining** **FBC Attaining** **DWS Attaining** **AgI Attaining** **AgL Attaining**	**1996-2000** **25 sampling events**	**OK**				**Attaining**	**US Geological Survey monitoring at 1 site for a total of 25 sample events. Reach assessed as "attaining all uses."**
Colorado River Indian Wash-Imperial Dam AZ15030104-001 A&Ww, FC, FBC, DWS, AgI, AgL	USGS Station 09429490 Above Imperial Dam CMCLR029.79	1996 - 1 suite 1997 - 6 suites 1998 - 6 suites 1999 - 6 suites 2000 - 3 suites	OK					Missing core parameters: total mercury, arsenic, beryllium, barium, fluoride, copper, manganese, and Escherichia coli.
	Reach Summary Row **A&Ww Attaining** **FC Inconclusive** **FBC Inconclusive** **DWS Inconclusive** **AgI Inconclusive** **AgL Inconclusive**	**1996-2000** **22 sampling events** **Missing core parameters**	**OK**				**Attaining**	**US Geological Survey monitoring at 1 site for a total of 22 sample events. Reach assessed as "attaining some uses" and was placed on the Planning List due to missing core parameters.**
Colorado River Main Canal-Mexico border AZ15030107-001 A&Ww, FC, FBC, AgI, AgL	USGS Station 09522000 International boundary (Mexico) CMCLR015.85	1996 - 4 suites 1997 - 4 suites 1998 - 6 suites 1999 - 6suites 2000 - 6suites	OK					

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA								
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	**AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID**	**YEAR SAMPLED NUMBER AND TYPE OF SAMPLES**	**STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT**					
			PARAMETER UNITS	**STANDARD (DESIGNATED USE)**	**RANGE OF RESULTS (MEAN)**	**FREQUENCY EXCEEDED STANDARD**	**DESIGNATED USE SUPPORT**	**COMMENTS**
	Reach Summary Row **A&Ww Attaining** **FC Attaining** **FBC Attaining** **DWS Attaining** **AgI Attaining** **AgL Attaining**	**1996-2000** **26 sampling events**	**OK**				**Attaining**	**US Geological Survey monitoring at 1 site for a total of 26 sample events. Reach assessed as "attaining all uses."**
Gila River Coyote-Fortuna AZ15070201-003 A&Ww, FC, FBC, AgI, AgL	ADEQ Fixed Station Network Near Dome, USGS #09520500 LGGLR005.75 100455	1996 - 5 suites 1997 - 3 suites 1998 - 4 suites 1999 - 4 suites 2000 - 4 suites	Boron (total) µg/L	1000 (AgI)	100-1500	4 of 20		
			Dissolved oxygen mg/L	6.0 90% saturation (AW&w)	3.22-11.8 40% - 125%	1 of 18		
			Thallium µg/L	12 (FBC)	2.0 - 20	1 of 19		
	Reach Summary Row **A&Ww Attaining** **FC Attaining** **FBC Attaining** **AgL Attaining** **AgI Inconclusive**	**1996-2000** **20 sampling events**	**Boron (total) µg/L**	**1000 (AgI)**	**100-1500**	**4 of 20**	**Inconclusive**	**ADEQ collected 20 samples in 1996-2000. Agriculture Reach assessed as "attaining some uses" due to boron exceedances.**
			Dissolved oxygen mg/L	**6.0 90% saturation (AW&w)**	**3.22-11.8 40% - 125%**	**1 of 18**	**Attaining**	
			Thallium µg/L	**12 (FBC)**	**2.0 - 20**	**1 of 19**	**Attaining**	
LAKES MONITORING DATA								
Lake Havasu AZL15030101-0590 A&Ww, FC, FBC, DWS, AgI, AgL	Mohave County Swimming Area Monitoring CMHAV	2000 - 867 bacteria	OK					
	ADEQ Lakes Program Dam Site, Parker Dam CMHAV-A 100098	1996 - 2 suites 1997 - 2 suites 1998 - 1 suite 2000 - 2 suites	OK					Missing core parameters: bacteria
	ADEQ Lakes Program CMHAV-B 100102	1996 - 2 suites 1997 - 2 suites 1998 - 1 suite 2000 - 2 suites	OK					
	ADEQ Lakes Program CMHAV-C 100099	1996 - 2 suites 1997 - 2 suites 1998 - 1 suite	OK					
	ADEQ Lakes Program Colorado River CMHAV-CRA 100101	1996 - 2 field 1997 - 1 field 1998 - 1 field 2000 - 2 suites	OK					
	ADEQ Lakes Program Crazy Horse Cove CMHAV-CHC 100139	2000 - 1 field, 1 bact	OK					

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA								
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED NUMBER AND TYPE OF SAMPLES	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATED USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	ADEQ Lakes Program CMHAV-E 100100	1996 - 2 suites 1997 - 1 suite, 1field 1998 - 1 field	OK					Missing core parameters: bacteria
	ADEQ Lakes Program Grass Island CMHAV-GI 100144	2000 - 1 bact	OK					
	ADEQ Lakes Program Hole in Rock CMHAV-HIR 100145	1996 - 2 field 1997 - 2 field 1998 - 1 field	OK					
	ADEQ Lakes Program Off Windsor Beach CMHAV-OFFWB 100155	2000 - 1 field	OK					
	ADEQ Lakes Program Pilot Rock CMHAV-PR 100157	1999 - 2 field 2000 - 1 field	Turbidity NTU	25 (A&Ww)	0.4-77.4	1 event out of 3		(During one sampling event the median turbidity reading was 28.6)
	ADEQ Lakes Program Thompson Bay @ East State Beach Shore CMHAV-ESB 100141	1996 - 2 field 1997 - 2 field 1998 - 1 field 1999 - 1 bact 2000 - 1 field, 1 bact	OK					
	ADEQ Lakes Program Thompson Bay @ East State B. CMHAV-ESBSH 100117	1996 - 2 field 1997 - 2 field	OK					
	ADEQ Lakes Program Thompson Bay @ Golf Course West Shore CMHAV-GCPWS 100143	1996 - 2 field	OK					
	ADEQ Lakes Program Thompson Bay @ Golf Course CMHAV-GCP 100142	1996 - 2 field 1997 - 2 field	OK					
	ADEQ Lakes Program Thompson Bay @ Marina CMHAV-MARA 100167	2000 - 1 suite	OK					
	ADEQ Lakes Program Thompson Bay @ Mid Bay CMHAV-MB 100149	1999 - 1 field 2000 - 2 field	OK					
	ADEQ Lakes Program Thompson Bay @ Mid Channel CMHAV-MC 100150	1999 - 1 bact 2000 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay @ Nautical Bch CMHAV-NB-A 100153	1999 - 1 bact 2000 - 1 field	OK					

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA								
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED NUMBER AND TYPE OF SAMPLES	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATED USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	ADEQ Lakes Program Thompson bay @ Nautical Beach (off volleyball courts) CMHAV-NBEAC 100152	1999 - 1 bact	OK					
	ADEQ Lakes Program Thompson Bay @ Rotary Beach CMHAV-ROT1 100121	1996 - 1 field 1999 - 1 bact	OK					
	ADEQ Lakes Program Thompson Bay @ Rotary Beach CMHAV-ROT2 100159	2000 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay @ Rotary Beach CMHAV-ROT3 100122	1996 - 1 field 1999 - 1 bact	OK					
	ADEQ Lakes Program Thompson Bay @ Rotary Beach CMHAV-ROT3 100123	1996 - 1 field 1999 - 1 bact 2000 - 1 bact	OK					
	ADEQ Lakes Program Thompson Bay @ Nautical Cove CMHAV-NAUTC 100151	1996 - 1 field 1997 - 1 field 1999 - 1 bact 2000 - 1 field, 1 bact	OK					
	ADEQ Lakes Program South Channel CMHAV-SC 100164	1999 - 1 bact 2000 - 1 field, 1 bact	OK					
	ADEQ Lakes Program Thompson Bay - West State B. CMHAV-WSB 100166	1996 - 2 field 1997 - 2 field 1999 - 1 bact 2000 - 1 field, 1 bact	OK					
	ADEQ Lakes Program Thompson Bay - West State B. CMHAV-WSBSH 100171	1996 - 2 field 1997 - 2 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-137152 100129	1996 - 2 field 1997 - 2 field 1999 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-137 100125	1996 - 2 field 1997 - 2 field 1999 - 1 field	OK					

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA								
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED NUMBER AND TYPE OF SAMPLES	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATED USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	ADEQ Lakes Program Thompson Bay CMHAV-140 100126	1996 - 2 field 1997 - 2 field 1999 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-OW140 100169	1996 - 1 field 1997 - 1 field 1998 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-142 100127	1996 - 2 field 1997 - 2 field 1999 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-144 100144	1996 -1 field 2000 -1 suite	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-147 100174	1997 - 1 field 1998 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-149 100177	1996 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-152 100094	1996 - 2 field 1997 - 2 field 1999 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-152WS 100181	1996 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-149WS 100178	1996 - 1 field	OK					
	ADEQ Lakes Program Thompson Bay CMHAV-OW149 100170	1996 - 1 field 1997 - 2 field 1999 - 1 field	OK					
	Reach Summary Row **A&Ww Attaining** **FC Attaining** **FBC Attaining** **DWS Attaining** **AgL Attaining**	**1996-2000** **129 Chemistry samples** **6 sampling events** **867 bacterial samples**	**Turbidity** **NTU**	**25** **(A&Ww)**	**0 -77.4**	**1 of 112 spatially and temporally independent samples.**	**Attaining**	**ADEQ monitoring at 40 sites with a total of 129 samples. Additionally, Mohave County conducted bacteria monitoring at 6 sites with a total of 867 bacterial samples. This lake is assessed as "attaining all uses."**
Lake Mohave AZL15030101-0960 A&Wc, FC, FBC, DWS, AgI, AgL	ADEQ Lakes Program CMMOH - A 100030	1996 - 1 suite	OK					Missing core parameters: bacteria
	ADEQ Lakes Program CMMOH - CRMR 100031	1996 - 1 field	OK					

TABLE 10. COLORADO - LOWER GILA WATERSHED -- 2002 ASSESSMENT -- MONITORING DATA								
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY AND PROGRAM SITE DESCRIPTION SITE CODE ADEQ DATABASE ID	YEAR SAMPLED NUMBER AND TYPE OF SAMPLES	STANDARDS EXCEEDED AT THIS SITE PER SAMPLING EVENT					
			PARAMETER UNITS	STANDARD (DESIGNATED USE)	RANGE OF RESULTS (MEAN)	FREQUENCY EXCEEDED STANDARD	DESIGNATED USE SUPPORT	COMMENTS
	ADEQ Lakes Program CMMOH - CRRR 100032	1996 - 1 field	OK					
	ADEQ Lakes Program CMMOH - E 100033	1996 - 1 suite	OK					
	AGFD Routine Monitoring Near El Dorado	1996 - 2 suites	OK					Missing core parameters: turbidity, bacteria, all metals, fluoride, boron, barium,
	AGFD Routine Monitoring Near Monkey Rock	1996 - 2 suites	OK					
	AGFD Routine Monitoring Near Hoover Dam	1996 - 2 suites	OK					
	AGFD Routine Monitoring Near Ringbolt Rapids	1996 - 2 suites	OK					
	Reach Summary Row **A&Ww Inconclusive** **FC Inconclusive** **FBC Inconclusive** **DWS Inconclusive** **AgL Inconclusive**	**1996** **9 samples** **3 sampling events** **Missing core parameters**	**OK**				**Inconclusive**	**ADEQ monitored 4 sites during 1 sample event and Arizona Game and Fish Dept. monitored 4 sites during 2 sample events. This lake is assessed as "inconclusive" due to insufficient parametric coverage and was placed on the Planning List.**
Painted Rock Borrow Pit Lake AZL15070201-1010 A&Ww, FC, FBC, AgI, AgL	USFWS/COE Routine Monitoring LGPRL	1996 - 6 suites, 2 Sulfide 1997 - 5 suites 1998 - 5 suites, 2 DO 1999 - 8 suites 2000 - 2 field, 1 bact, 2 nutrients	Dissolved oxygen mg/L	6.0 90% saturation (A&Ww)	1.77-19.82	7 of 30		
			Sulfide mg/L	0.1 (A&Ww)	0.0-40	1 of 24		
			Fecal Coliform CFU/100 ml	4000 (A&Ww, FBC, AgL)	10-200,000	5 of 21		
			pH (high) SU	6.5-9.0 (FBC, AgL)	6.99-9.46	1 of 30		
	Reach Summary Row **A&Ww Impaired** **FC Inconclusive** **FBC Attaining** **AgI Impaired** **AgL Impaired**	**1996 -2000** **sampling events 30**	**Dissolved oxygen** **mg/L**	**6.0** **90%saturation** **(A&Ww)**	**1.77-19.82**	**7 of 30**	**Impaired**	**US Fish and Wildlife Services conducted monitoring at 1 sites with a total of 30 sample events. Lake assessed as "impaired" due to fecal coliform and low dissolved oxygen.** **Fish tissue contamination by historically used pesticides has lead to a fish consumption advisory. FC is assessed as inconclusive.**
			Fecal Coliform **CFU/100 ml**	**4000** **(A&Ww, AgI, AgL)**	**10-200,000**	**5 of 21**	**Impaired**	
			pH (high) **SU**	**6.5-9.0** **(FBC, AgL)**	**6.99-9.46**	**1 of 30**	**Attaining**	
			Sulfide **mg/L**	**0.1** **(A&Ww)**	**0.0-40**	**1 of 24**	**Attaining**	

Information for interpreting these Monitoring Tables

- "Segment" designates the beginning and end points of the reach.
- "Waterbody ID" is derived from combining the following: AZ (for streams) or AZL (for lakes) + a US Geological Survey Hydrologic Unit Code + EPA stream reach number or ADEQ lake number.
- "Designated Uses," "Agency," and "Units" (of measurement) abbreviations are defined in Appendix A.
- "Site Code" is an ADEQ derived abbreviation for the surface water basin, stream name or lake name, and the location of the site. For streams, the numbers are the miles upstream from mouth (normally measured as a straight line vector).

- “ADEQ Database ID” -- This is ADEQ’s water quality database reference number. If the data is not in this database, no number will be shown.
- “Samples” -- The year and number of water samples is shown. The federal “water year” is used, from October 1st through September 30th, rather than the calendar year. Types of samples:
    - “Suite” indicates that a broad range of chemical constituents were collected and field measurements were taken (normally inorganics, metals, nutrients, and bacteria.) The chemical constituents monitored are not consistent among the many monitoring entities that provided the data. If the suite did not include the core parameters needed to assess a designated use as “attaining,” the missing core parameters are indicated.
    - “Field” indicates that only field measurements such as dissolved oxygen, pH, turbidity, and water temperature were collected.
    - If a specific parameter or parametric group (e.g., zinc, metals, bacteria) is named, monitoring was limited to only these parameters
- “Standards Exceeded at this Site per Sampling Event.”
    - Although many parameters may be analyzed, only those exceeding a standard are shown. Other parameters were collected.
    - “OK” indicates that no standards were exceeded.
    - The specific standards are shown as a single parameter may have multiple standards depending on the designated uses assigned. (See standards in Appendix C.)
    - “The Range of Results” indicates the minimum and maximum sample results. If the laboratory reported result is “less than the detection limit” or “not detected,” a less than (<) value will be shown along with the detection limit (e.g., <0.5 mg/L).
    - A mean, geometric mean, or median will be shown along with the range of results if applicable to the standard or assessment criteria.
- “Comments” include other information used in interpreting the data for assessments, such as evidence that exceedance is solely due to natural conditions, or that the data does not meet the new “credible” data requirements.
- In the “Summary Row” parameter exceedances are combined from multiple sites, and the assessment of each designated use is shown. The overall assessment for the surface water is described in the “Comments” field: “Attaining,” “Not attaining,” “Impaired,” or “ Inconclusive.” See assessment criteria in Chapter III of Volume I.

Ground Water Assessments in the Colorado-Lower Gila Watershed

Major Ground Water Stressors -- Monitoring data collected from wells in this watershed between October 1995-October 2000 are summarized in **Table 11** and illustrated in **Figure 18, 19, and 20.** As **Table 11** indicates, wells are sampled for different constituents.

Many of the wells monitored **(Figure 18)** were part of two ground water basin studies conducted in this watershed Section. These studies provide a lot of information about water quality in this watershed. See the discussion of these two studies in the Watershed Studies and Alternative Solutions (following the maps).

All of the radiochemical exceedances appear to be related to the Sacramento Ground Water Basin study. Fluoride and nitrate contamination seems to be widespread across the watershed, while metal and volatile organic chemicals contamination is isolated in pockets. It is interesting to note that although significant irrigated crop production has occurred in this watershed, no pesticides exceeded any standards and only six (6) wells among the 120 wells monitored even detected pesticides. Note that wells are not normally sampled for radiochemicals, volatile organic chemicals, or pesticides, except as part of a special study or investigation due to the high costs of running these analyses.

TDS Concentrations – Water quality can be characterized based on concentration of Total Dissolved Solids. High levels of salinity limits the practical uses of ground water in some areas of this watershed as TDS over 500 mg/L has an off-flavor, and TDS over 1000 mg/L will limit its use for some crops. Of the 151 wells monitored for TDS, 85% were over 500 mg/L and 61% were over the 1000 mg/L. As illustrated in **Figure 19**, very high TDS concentrations occur in wells in the Yuma area. (See TDS discussion in the Yuma Groundwater Basin study.)

A flow-weighted average annual salinity surface water standard is established on the Colorado River below Hoover Dam, below Parker Dam, and at Imperial Dam in this watershed. These standards were established by Arizona as part of the federally administered Colorado River Basin Salinity Control Program, and these standards are being met. (More information about the Colorado River Basin Salinity Control Program is provided in the statewide research discussion of this report.)

The elevated levels of TDS do not present a human-health concern for drinking waters. The TDS concentration is only used to generally characterize water quality.

Nitrate Concentrations – Water quality can also be characterized by looking at the concentration of nitrates in ground water. Naturally occurring nitrate concentrations in ground water are generally below 3 mg/L. Concentrations above 5 mg/L indicate potential anthropogenic sources of nitrate. Of the 196 wells monitored for nitrate, 30% exceeded this 5 mg/L concentration. As illustrated in **Figure 20**, these wells are scattered across the watershed. These areas may be related to historic irrigated agriculture or septic systems.

When nitrate concentrations exceed 10 mg/L, Arizona's Aquifer Water Quality Standard has been exceeded. This standard was set to protect human health , as water with nitrate greater than 10 mg/L may present a health problem for babies and should not be consumed by nursing mothers. Thirty-five of the 196 wells monitored (18%) exceeded 10 mg/L. As many of these wells may be irrigation wells (not used for drinking water), nitrates over 10 mg/L may not represent a human-health concern. However, efforts should be made to minimize further contamination of ground water by nitrate.

Table 11. Colorado-Lower Gila Watershed Ground Water Monitoring 1996 - 2000

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS			PERCENT OF WELLS EXCEEDING STANDARDS
		SAMPLED	SYNTHETIC CONSTITUENT DETECTED*	EXCEEDING STANDARDS	
INDEX WELLS	Radiochemicals	34		8	23%
	Fluoride	43		2	5%
	Metals/Metalloids	43		0	0%
	Nitrate	44		8	19%
	VOCs + SVOCs*	39	2	0	0%
	Pesticides	39	2	0	0%
TARGETED MONITORING WELLS	Radiochemicals	6		4	67%
	Fluoride	142		27	10%
	Metals/metalloids	153		12	8%
	Nitrate	152		27	18%
	VOCs + SVOCs*	81	11	8	10%
	Pesticides	81	4	0	0%

WELL CLASSIFICATION BY TOTAL DISSOLVED SOLIDS (TDS) CONCENTRATION				
Total Number of Wells	Wells <500 mg/L Acceptable drinking water flavor	Wells 500-999 mg/L Fresh (not saline) Some crop production problems	Wells 1000-3000 mg/L Slightly saline Increasing crop production problems	Wells >3000 mg/L Moderately saline to briny Severe crop production problems
151	22	37	80	12

WELL CLASSIFICATION BY NITRATE CONCENTRATION (measured as Nitrogen)			
Total Number of Wells	Wells <5 mg/L	Wells 5-10 mg/L May be an anthropogenic source of Nitrates	>10 mg/L Exceeds standards Should not be used for drinking water by babies or nursing mothers
196	137	24	35

*VOCs = volatile organic compounds; SVOCs = semi-volatile organic compounds.
*The detection of a synthetic constituent (pesticides, VOCs, and SVOCs) is noted because some do not have standards and these substances are not naturally occurring in the ground water.

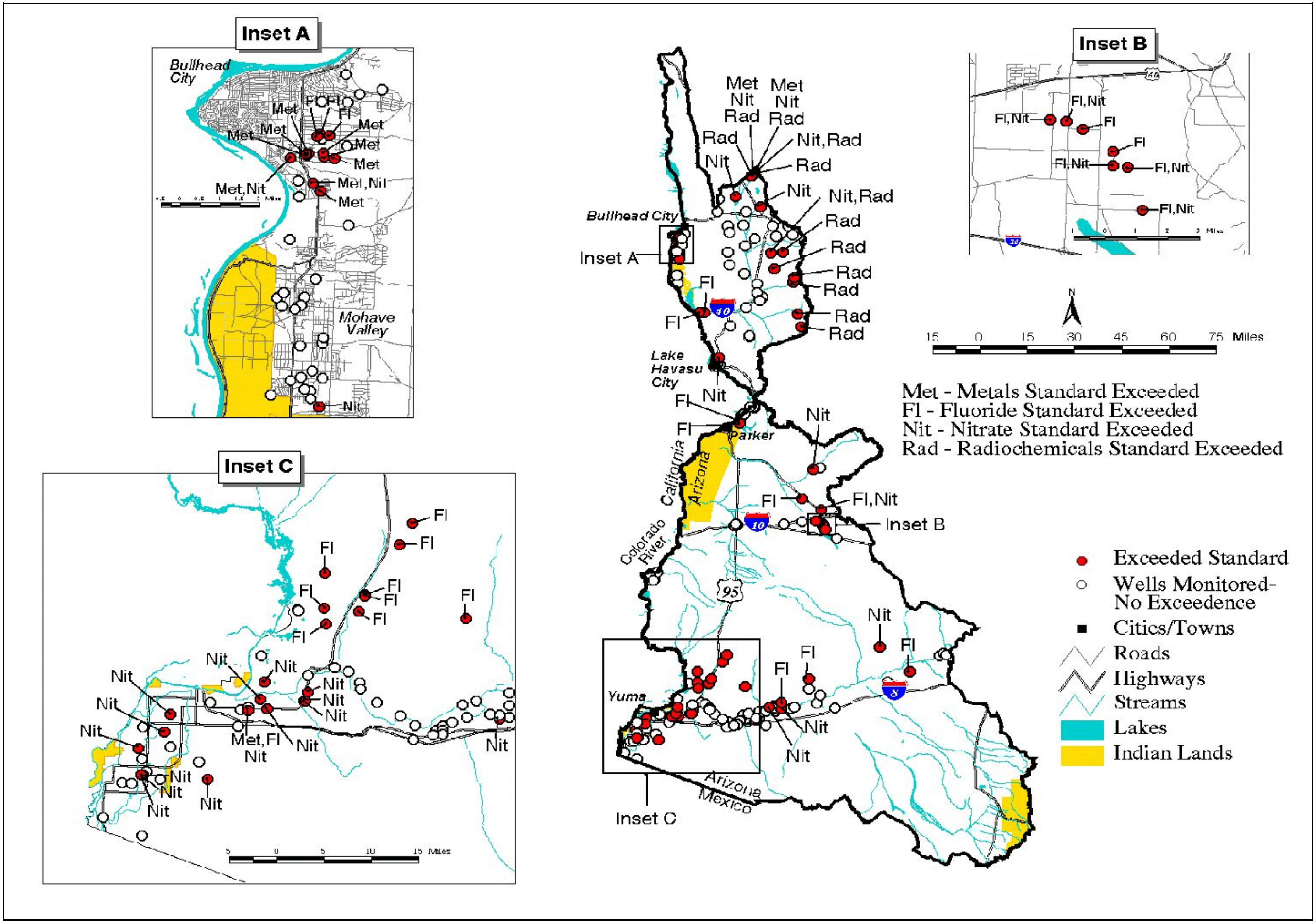

Figure 18. Ground Water Quality Monitoring in the Colorado-Lower Gila Watershed – 1996-2000

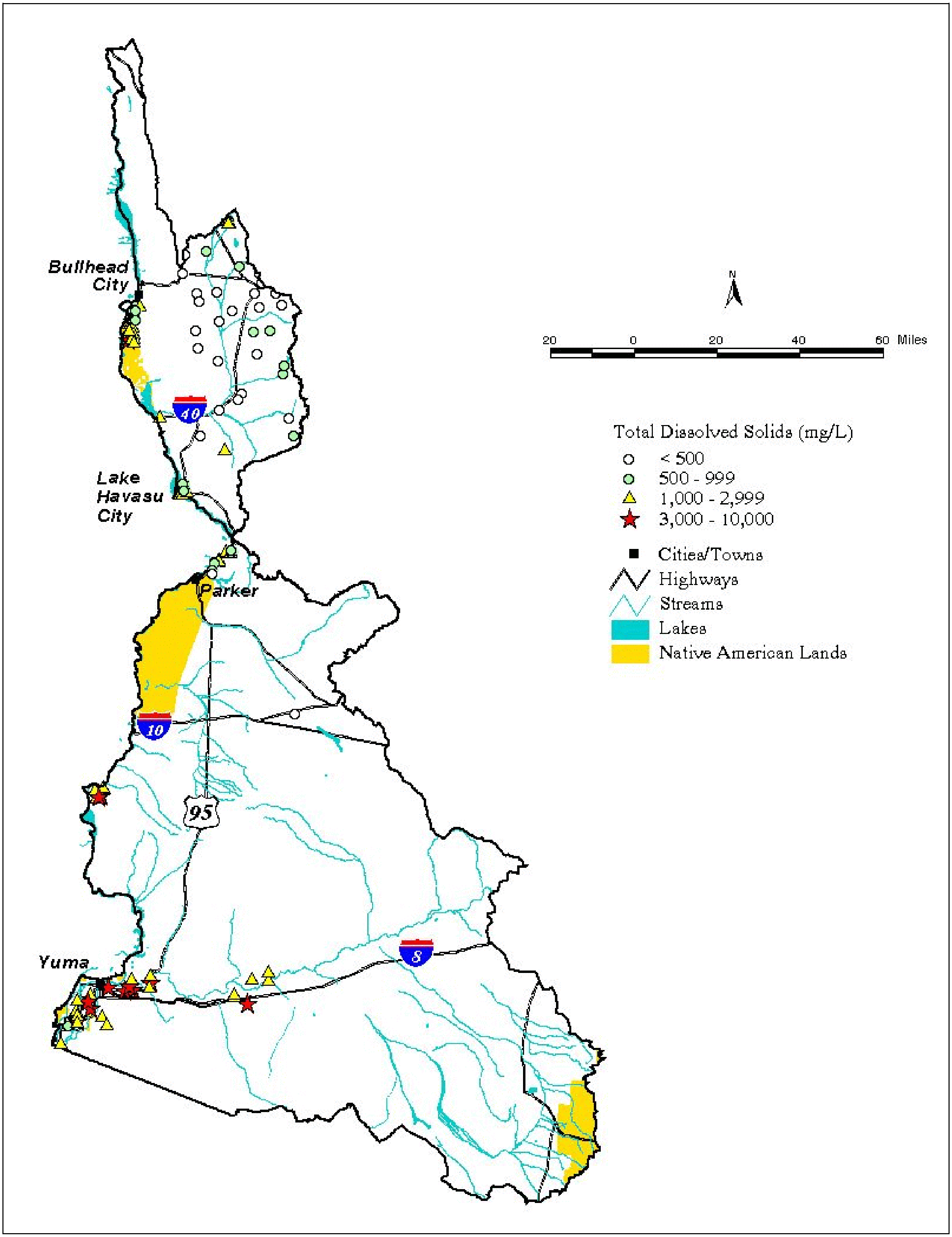

Figure 19. Ground Water Quality by TDS Concentration in the Colorado-Lower Gila Watershed

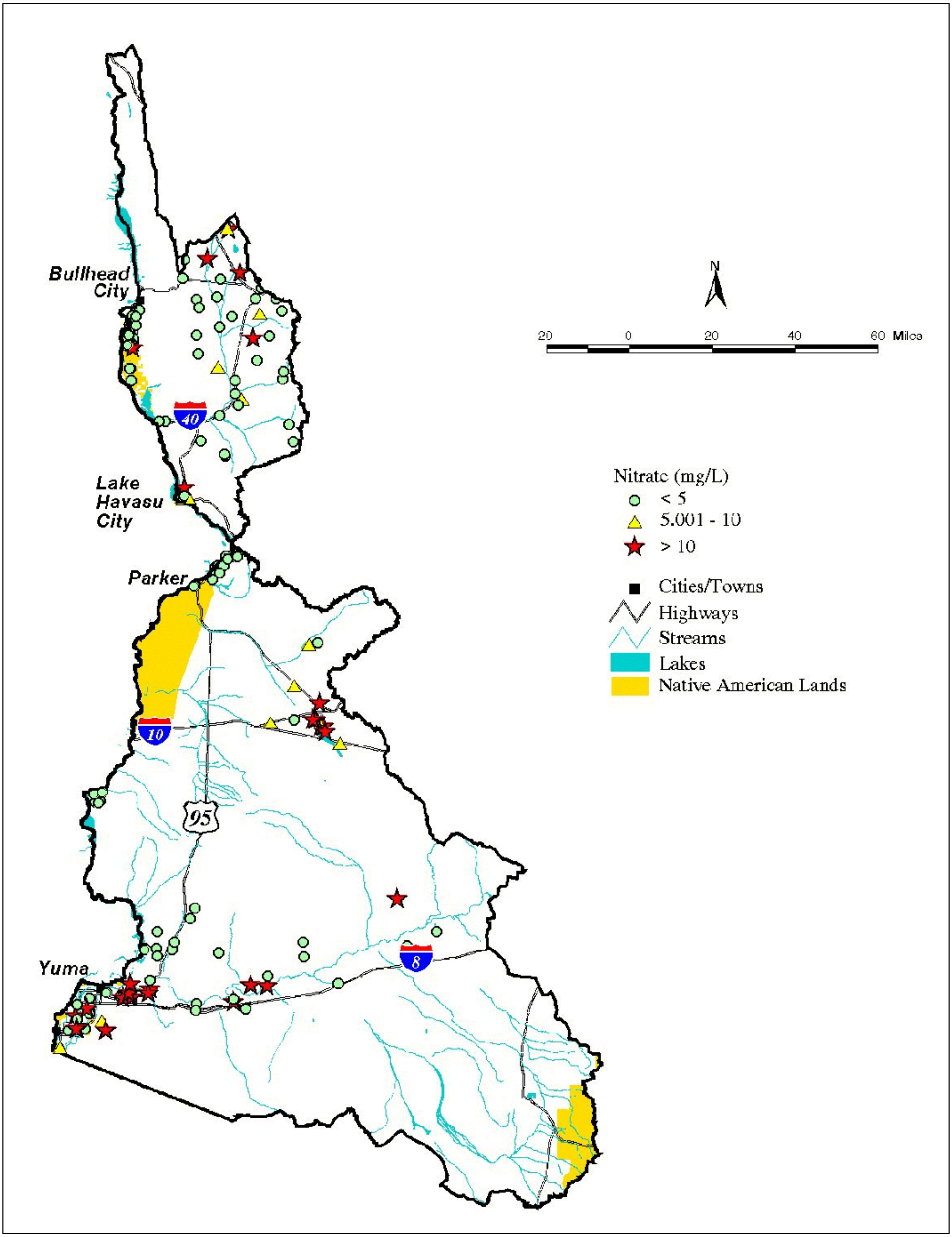

Figure 20. Ground Water Quality by Nitrate Concentration in the Colorado-Lower Gila Watershed

Watershed Studies and Alternative Solutions in the Colorado-Lower Gila Watershed

This section highlights surface and ground water studies, mitigation projects, and remediation activities which have been conducted to improve water quality in the Colorado-Lower Gila Watershed. Watershed partnerships active in this watershed are also mentioned.

Surface Water Studies and Mitigation Projects

Yuma East Wetlands Restoration – The Yuma East Wetlands extends along the Colorado River from the Gila confluence to the Ocean-to-Ocean Bridge between the north and south river levees. The restoration area includes 1100 acres of riparian habitat, 148 acres of open water, 98 acres of marshland, and 20 acres of agriculture. The Yuma East Wetlands Restoration Plan (developed by Philips Consulting for the River Front Development Office, City of Yuma) aims to restore native riparian, wetland, and aquatic habitats along the lower Colorado River and create an interpretive, cultural center, and nature park for education and low-impact recreation opportunities.

Over the past century, riparian areas surrounding the Yuma East Wetlands have been drastically altered. Fires and human consumption have decimated native stands of cottonwood, willow, and mesquite (honey and screwbean), while the non-native salt cedar populations have overrun the river area. The historic damming and confinement of the river channel have decreased seasonal flooding, ending the natural process of soil desalinization. Where soil salt levels have increased, trees such as the cottonwood and willow, which cannot tolerate high soil salt levels, have been unable to thrive and regenerate. Thus, salt cedar (perfectly suited to high salt levels) thrives in the absence of serious competition from native plant species. Unfortunately, salt cedar, for various reasons, supports less wildlife than native vegetation. Wildlife populations, especially migratory bird populations, have declined with the loss of suitable habitat.

While simple replacement of salt cedar by native vegetation is problematic, the restoration of native vegetation through removal of exotic species on the first (lower) terrace, the use of excavated materials to assure hospitable soil for a second terrace, along with extensive soil sampling at planting sites, should encourage the return of native vegetation and wildlife. In conjunction with these proposed actions, the natural sediment influx and flooding from the Gila River will allow for the continued regeneration of native plants (such as cottonwood and willow).

Yuma East Wetlands revegetation activities will commence in areas deemed suitable for revegetation. Site selection criteria will be established to select optimum revegetation areas. The goal is to maximize successful establishment of native species, minimize amount of future maintenance required, and design stands to minimize threat from wildfire.

Revegetation activities will be monitored for success, to guide future maintenance activities and optimize future revegetation projects on the lower Colorado River. Monitoring will include bird censuses to establish base line data, protect sensitive species, and monitor success of revegetation efforts.

An interpretive center and nature park is proposed to act as the main staging area for the entire project. This area could accommodate the Yuma East Wetlands offices, a children's center, traditional gardens, ceremonial grounds, a swimming beach and fishing area, picnic areas, shade ramadas, and a trail system that connects the interpretive center with the surrounding historical sites. This area may also serve as an outdoor, cultural and environmental classroom for community schools and organizations. It will be ideal for hosting traditional community gatherings, field trips, special interest groups, summer camps and act as a staging ground for Yuma East Wetland activities.

Other low-impact recreational opportunities in the Yuma East Wetlands will include bird observation platforms with interpretive signs, a canoe trail along the main river channel with primitive day use facilities and wildlife/bird watching trails in the restored areas.

The combination of restoration, education, and intercommunity involvement will add to the success of this important restoration project. The projects goals include the following items:

- Enhance the natural river channel dynamics by manipulating sediment loads, thereby decreasing river maintenance requirements.

- Excavate historic channels to improve water quality and flow in the existing wetlands.
- Stabilize excavated channel material, riverbanks, and sensitive lowland sites using revegetation methods.
- Improve hydrology and enhance wetlands and backwaters utilizing new and existing water control structures, such as the filtered effluent from the city of Yuma water plant.
- Create and enhance fish and wildlife habitats in the wetlands.
- Establish native fish habitat, isolated from the main river channel.
- Establish an interpretive, cultural center, and nature park for education and low-impact recreation opportunities.
- Improve safety and aesthetic value by cleaning up illegal dumping sites in the project area.
- Reduce the amount of undesirable and illegal human activities by relocating homeless Yuma East Wetland residents in a respectful and helpful manner.
- Involve the Quechan and Yuma communities throughout all aspects of the restoration operations. Respect Quechan Tribal cultural resources and values throughout the planning and restoration process. Provide cultural, educational and economic opportunities for the Yuma and Quechan communities.

In addition to the Quechan Indian Nation, this project involves a number of public and private landowners and stakeholders including, the City of Yuma, the Bureau of Land Management, the Bureau of Reclamation, Arizona State Land Department, United States Fish and Wildlife, Arizona Game and Fish. It is important that the wildlife and natural resources of this area be preserved for present and future generations.

Regrowth of Fecal Coliform in Swim Areas of Lake Havasu, Arizona -- In 1994, extremely elevated concentrations of fecal coliform bacteria (greater than 80,000 CFU/100 ml) were detected in several swim areas of Lake Havasu, and another occurrence at lower concentrations the following year. Because these concentrations far exceeded the Arizona surface water quality standard for swimming areas (800 CFU/100 ml at that time), many swim areas were closed in 1994 and 1995, disrupting the economy of the commercial resorts and recreation areas.

ADEQ led extensive investigations into the nature and cause of these high bacteria concentrations (ADEQ, 1997). The investigations focused on the following aspects of the phenomenon:

- Spatial and temporal distribution of bacteria in swimming area waters;
- Chemistry of lake water, ground water, and shoreline sediments;
- Speciation of bacteria within the fecal coliform group and related microbiological investigations of parasites, viruses, and pathogenic organisms;
- Thermal structure and hydraulic characteristics of the lake;
- Water and nutrient materials balance of the municipal wastewater treatment plant located on an island in Havasu Lake and the treatment plants related irrigation and fertilization practices; and
- Regrowth of fecal coliform bacteria in shoreline sediments and water.

This report indicates a link between the discharge of wastewater from the city's onsite wastewater treatment plant, elevated water temperatures, and elevated *Escherichia coli* in swimming areas. The link is not based on the transport of bacteria, but may be due to nutrient enrichment. Long-term recommendations included reducing and eliminating the discharge of effluent on the Island. Short-term recommendations encouraged the dredging, resanding, and rototilling all beaches and coves where fecal coliform exceeded the standards.

Water Quality Improvement Grant Projects – ADEQ has awarded the following Water Quality Improvement (319h) Grants:

- <u>The Greater Kingman Wildcat Dump Cleanup Project</u> – (See discussion in the Colorado-Grand Canyon Watershed.)

Water Protection Fund Projects – The following projects received Water Protection Funds from ADWR.

- <u>Lower Colorado River - Imperial Diversion Restoration</u> – The Bureau of Reclamation is restoring stream flow to small backwater channels and about 50 acres of dried-out wetlands along the lower Colorado River. Areas will be revegetated with native riparian plant species. The grantee hopes to create higher quality riparian and aquatic habitat along this reach of the river.

- <u>Ahakhav Tribal Preserve - Deer Island Revegetation</u> – The Ahakhav

Tribal Preserve on the Colorado River Indian Reservation is approximately 1042 acres in size. The construction of dams and channelization of the Colorado River, as well as the introduction of the exotic and invasive salt cedar, has left the Preserve nearly devoid of cottonwoods and willows. Because salt cedar does not provide adequate cover, food and thermal protection, this habitat type supports a significantly lower diversity of insects, birds and other wildlife. The Colorado River Indian Tribes removed low-quality exotic plants near the Deer Island backwater, and revegetated the site with native plants including cottonwood, willow, mesquite, wolfberry and four-wing saltbush. The project was completed in 2000.

- Watershed Restoration at the Yuma Conservation Gardens – Yuma Conservation Garden received funding to renovate a five acre model watershed that is used as an outdoor classroom at the Yuma Conservation Garden. The Garden is a 28-acre natural area established in the 1950's for education and recreational purposes. The project area was established in 1962, and is used to teach the public about watershed issues in the Yuma area. The project was completed in 2000.

Colorado River Sediment Chemical Analysis – In 1998, the Bureau of Reclamation collected sediment samples of the Colorado River from the Morelos Dam to the confluence with the Gila River. The purposed of the study was to assist in evaluating dredging options, including disposal of dredged materials. Samples were collected every two miles and at three depths: surface, five to ten feet, and 10 to 15 feet.

Results indicated that soils in this segment are typically sands, with low levels of toxic contaminants. For this reason, the US Army Corps of Engineers classifies these soils as “category 1" materials which do not require further sampling and testing under section 404 of the Clean Water Act governing dredge and fill activities.

Colorado River Basin Salinity Control Program – (See previous discussion in Section III of this report.)

US Fish and Wildlife Service Studies – The US Fish and Wildlife Service has conducted several studies to look at contaminants in bottom sediments, fish, and wildlife. The following studies have been recently completed by them or by University of Arizona (UA) students under grants from the USFWS.

- *Dynamics of Selenium in Cibola Lake, Arizona*. This is a UA PhD dissertation completed in 1997 by S.V. Villegas.
- *Selenium and Water Quality in Three Wetland Types along the Lower Colorado River – Imperial National Wildlife Refuge.* This is a UA masters thesis by F.G. Prieto, written in1998.
- *Reproductive impacts of elevated selenium levels.* This was completed by K.D. Estrada and O.E. Maughan at the UA in 1999.
- *Environmental contaminants in Fish and Wildlife of Havasu National Wildlife Refuge, Arizona* was published in 1996. This study was designed to assess the level of selenium, organochlorine pesticides (historically applied pesticides), and trace elements in fish and migratory birds of the Colorado River adjacent to and within the Havasu National Wildlife Refuse. The following conclusions were made in this study:
  - The organochlorine pesticide compounds do not present a threat to fish and wildlife;
  - Elevated levels of arsenic, cadmium, chromium, copper, lead and selenium may be a concern to fish and wildlife.
  - Selenium concentrations were elevated in all biota, and research should continue to identify effects of selenium in fish and fish-eating birds, including monitoring reproductive success and teratogenesis (developmental malformations).
- *Field Screening of Water Quality Bottom Sediment, and Biota Associated with Irrigation Drainage in the Yuma Valley, Arizona, 1995* (Tadayon, King, Andrews, and Roberts, 1997). This study was completed in cooperation with the US Geological Survey. Water, bottom sediment, and biota were collected along the lower Colorado River and in agricultural drains at nine sites in the Yuma Valley, Arizona. The study made the following conclusions concerning water quality:
  - Selenium exceeded chronic Aquatic and Wildlife standards in only 1 sample;
  - Trace-element concentrations in bottom sediment samples from the study area were within the ranges found in soil of the western United States and do not indicate a significant accumulation.
  - DDE was detected in all fish and bird samples, and only one

sediment sample. Almost half of the fish contained DDE at levels 2.5 times higher than the national mean concentration, and 23% of the fish were 3 times the national mean. Although DDE was elevated in birds, fish, and eggs, concentrations generally were below thresholds associated with chronic poisoning and reproduction problems;

< Although 18 metals were detected in aquatic and wildlife, none occurred at a frequency or at concentrations that would cause concern for fish and wildlife populations, except for selenium in killdeer. Selenium in a killdeer-liver sample wa at potentially toxic levels.

- *Contaminants in Potential Prey of the Yuma Clapper Rail: Arizona and California, USA, and Sonora and Baja, Mexico, 1998-1999* was published in 2000. Potential food items for the Yuma clapper rail (a federally listed Endangered species) were collected along portions of the lower Colorado River below the Havasu National Wildlife Refuge. This report made the following conclusions and recommendations:

  < If selenium concentrations in crayfish (the primary prey species for the Yuma clapper rail) continue to increase two to five-fold (as it did in the past 10 years), the Yuma clapper rial populations, as well as those of other invertebrate and fish eating birds could experience selenium-induced reproductive failure and subsequent population declines. Further water management studies in backwater areas are needed.

  < Additional prey samples should be collected on a three to five year cycle to monitor trends in selenium bioaccumulation. If adult or nestling Yuma clapper rails are found dead, or unhatched eggs are located, samples should be collected for chemical analysis.

  < Monitor nests of Yuma clapper rails, or similar species, to determine reproductive success and document any anomalies in the young.

- *Contaminants in Bats Roosting in Abandoned Mines at imperial national Wildlife Refuge, Arizona, 1998-1999* was published in 2001. This report documents levels and potential effects of trace elements and organochlorine pesticide concentrations in four bat species collected from four abandoned mines on the Imperial National Wildlife Refuge and from three southern Arizona reference sites. Bats now have the highest percentage of endangered and candidate species among all land mammals in the United States. The study made no associations between contaminants in bats and water quality but was concerned with contaminated soils in and near the mines.

Ground Water Studies and Mitigation Projects

The Sacramento Valley Groundwater Basin Study – This ground water basin, located in northwestern Arizona, is an arid region with striking natural landscapes and a small, but rapidly growing population. Population increases are influenced by proximity to popular tourist destinations such as the Colorado River and Laughlin, Nevada, and by an abundance of relatively inexpensive and undeveloped private land. Ground water is the primary water source for municipal, domestic, industrial, mining, livestock, and irrigation in the basin. Population growth and associated economic development in the Sacramento Valley Groundwater Basin will likely increase demand on ground water and, over time, may influence water quality.

These ground water quality concerns prompted the Arizona Department of Environmental Quality to conduct a regional ground water quality study in 1999 to determine ground water suitability for drinking purposes, appraise current baseline conditions, and examine spatial ground water quality patterns.

Of the 48 sites sampled in this basin, only 54% met health-based aquifer water quality standards, and only 42% met aesthetics-based criteria. Water quality standard exceedances were identified in the following three principal areas:

- <u>Near the town of Chloride</u>, radiochemicals exceedances appear to be related to granite rock that occurs in much of the Hualapai and Cerbat Mountains. Radionuclide levels in ground water may have been exacerbated by the nearby historic and current mining activity. Nitrate exceedances also occur in this area. These exceedances may be related to the high-density of older septic systems used for domestic and commercial wastewater treatment. These systems are often situated in soils that are marginally suitable for septic use.
- <u>In the central and southern Hualapai Mountains</u>, radiochemistry exceedances also occur. In addition, aesthetic-based criteria for TDS, chloride, and sulfate were exceeded in or near the Cerbat and Hualapai Mountains. Previous studies have noted that ground water found in and near mountains is generally more mineralized than ground water

in the center of the valley. Different geologic classifications, recharge sources, and precipitation reactions may contribute to this ground water quality pattern.

- Near the town of Topock, fluoride exceeds aquifer water quality standards, and TDS and chloride exceed aesthetic-based criteria. This may be due to dissolution reactions that increase constituent concentrations as ground water migrates down gradient within the basin.

The results of this study can be used in several ways, particularly to assist in the site selection for new wells for public or private drinking water supplies.

The Yuma Groundwater Basin Study - The Yuma Groundwater Basin, located in southwestern Arizona, is an area of startling geographic contrasts. Precipitation in this arid basin averages less than three inches annually, yet because of Colorado River irrigation, it is one of the world's most productive agricultural zones. Similarly, much of this is uninhabited desert, yet the basin has a large and growing population that increases seasonally with the arrival of a large winter visitor population. A variety of water related issues in the basin prompted the ADEQ to conduct a regional ground water quality study of this basin in 1995.

Ground water in the basin is fairly chemically uniform and similar to Colorado River water. This finding supports previous assertions that the ground water consists largely of recharged Colorado River water. Parameter concentration levels, particularly Total Dissolved Solids and major ions, are generally highest in Gila Valley, decline in Yuma Valley, and are lowest in Yuma Mesa.

The source of irrigation water appears to be a major factor in determining ground water quality. Colorado River water, diverted at Laguna Dam, has irrigated land in Yuma Valley and North Gila Valley since 1909. The Imperial Dam, constructed in 1938, largely replaced the functions of Laguna Dam. This dam extended Colorado River water for irrigation to the previously undeveloped Yuma Mesa in the 1940s and to portions of South Gila Valley in 1965, which had been irrigated with ground water since 1910.

Ground water quality often deteriorates in arid irrigated areas due to salt buildup as a result of evapotranspiration. The portion of irrigation water that is actually consumed by plants or lost to evaporation is virtually free of salts. Thus, the vast majority of salts that were in the original irrigation water remain and percolate down eventually to recharge the underlying aquifer. If ground water is pumped for irrigation use on nearby lands and the underlying aquifer receives recharge from the irrigation water applications, this continual recycling of ground water will dramatically increase the salinity of the aquifer over time. This process is exacerbated in areas of shallow ground water where the recycling process occurs quickly, as appears to be happening in South Gila Valley.

In contrast, recharging aquifers with Colorado River water that is lower in salinity (TDS) levels than the ground water would tend to have less of a cumulative salt load. Water percolating beneath Yuma Mesa moves toward the valleys and is extracted by drainage wells, further minimizing the salt impact there. These processes assist in explaining the high baseline salinity levels found throughout the Yuma Groundwater Basin, the particularly high salinity levels found in the Gila Valley where historically ground water has been used for irrigation, and the salinity differences among sub-areas.

Other factors such as irrigation history, ground water depth and movement, and soil type may also influence the Yuma Mesa's generally lower parameter levels. Irrigation on the mesa is a more recent phenomenon, and ground water depth is much greater. The high irrigation applications necessary to grow crops on the mesa's sandy soils (up to 22 acre-feet per year with citrus) quickly percolate. The resulting recharge and its associated salt load is largely flushed away from the ground water mound that has formed below the mesa toward both valleys. Interpretation of this study's results suggests that regional ground water quality conditions in the Yuma Groundwater Basin generally support drinking water uses, except for nitrate in the eastern South Gila Valley. However, Yuma area residents may prefer to use treated water or other sources for domestic purposes because of high salinity levels. Currently applied pesticides do not appear to be migrating to the ground water, perhaps because of their short half-lives. The banned pesticides, DBCP and EDB, which were detected in the early 1980s, appear to have been transported from the area via rapid ground water movement in the basin.

Cibola Ground Water Quality Study -- In 1997, ADEQ conducted a ground water quality study in Cibola, a small community located in southwestern La Paz County, Arizona. The area has experienced rapid development of winter and summer homes, and La Paz County expressed concerns that the related rapid increase of on-site wastewater disposal systems (septic systems) could pose a threat to ground water quality. La Paz County requested that ADEQ assist in collecting ground water quality data to identify potential sources of ground water contamination and assist in planning for future development.

ADEQ sampled five wells in the study area to evaluate the potential impacts from irrigated agriculture and on-site wastewater disposal systems on shallow ground water in this river aquifer system. Wells were sampled for dissolved metals, major cations and anions, nitrate and ammonia. None of these samples exceeded Arizona's Aquifer Water Quality Standards. However, aesthetic-based secondary drinking water criteria were exceeded in all five ground water samples as follows:

- Three wells exceeded 250 mg/L for chloride,
- Four wells exceeded 0.3 mg/L for iron,
- Five wells exceeded 0.05 mg/L for manganese
- Five wells exceeded 250 mg/L for sulfate, and
- Five wells exceeded 500 mg/L for total dissolved solids (TDS)

These high concentrations of chloride, sodium, sulfate, manganese and total dissolved solids contribute to aesthetically poor ground water quality (based upon taste, odor or color) in the study area. Although ground water in the study area is of poor aesthetic quality, use of ground water for drinking or cooking does not pose any significant health risk to the residents of the study area.

One sample had a nitrate (as nitrogen) level of 3.57 mg/L, well below the standard of 10.0 mg/L. It may indicate an anthropogenic source of nitrate since natural levels of nitrate are typically below 2 mg/L. Additional sampling would be necessary to determine the source of elevated nitrate levels but they can be added to the ground water by septic systems.

The ground water quality data collected will be useful to La Paz County as baseline data with which to measure the impacts of future development in the study area. The study recommended further monitoring to determine the source of elevated nitrate, and look at seasonal changes due to seasonal variations in population densities. The next study should expand the parameters to analyze for bacteria and where pesticides have been applied, sample for pesticides.

Federal and State Superfund Cleanup Sites -- Several state and federal Superfund and Department of Defense cleanup sites are located in the this watershed.

- <u>20th Street & Factor</u> – The 20th Street and Factor Avenue site in Yuma, Arizona was added to the WQARF Registry in 2000 because of ground water contamination by tetrachloroethene (PCE). The remedial investigation was initiated in November 1999 and completed in June 2001. The draft remedial investigation report and land and water use study will be completed by September 2001.

- <u>Yuma Marine Corps Air Station</u> -- The Marine Corps Air Station Yuma occupies approximately 3,000 acres within the city and county of Yuma, Arizona. In February of 1990, this site was designated a National Priority List Superfund site by the Environmental Protection Agency. The investigation has been concerned with soil and ground water contamination. The contaminants of concern in soil are asbestos in the form of non-friable asbestos containing material and petroleum hydrocarbons from a jet fuel leak. The asbestos containing material is scattered on top of and buried in the surface soil.

  In ground water, the contaminants of concern are trichloroethene (TCE), dichloroethene (DCE), tetrachloroethene (PCE) and petroleum hydrocarbons. The main ground water plume is approximately one mile long and 500 feet wide, and has reached the northwestern base boundary. The maximum concentration of total solvents is currently approximately 270 µg/L.

  History: The facility originated during World War II as a training base and is currently being used by the Marine Corps for the training of tactical aircrews. Environmental impacts due to soil contamination and subsequent infiltration to ground water may have resulted from activities at several areas of the base. The shop area (for aircraft and vehicle maintenance since the 1940s) has been the site of disposal and spills. Disposal of waste motor oil, cleaning solvents, battery acid, and anti-freeze occurred outside the base hobby shop from 1960 to the early 1980s. Routine maintenance of vehicles resulted in spills at another site. Materials that could not be recycled, such as waste fuel, were burned at three areas. The Radar Hill burn disposal area had the resultant ash pushed to the south and covered with soil. There are other base landfills that were used for waste disposal, as well as for the application of waste for dust control. Lagoons were built on the base for evaporative sewage treatment, but industrial wastewater was not segregated from domestic sewage waste. Some lagoons have contained oils, paints, acids, caustics, detergents, and photographic fixer and developer. Miscellaneous drummed, solid waste materials were removed for disposal in August 1992.

Remediation activities involved the offsite disposal of about 5000 cubic yards of asbestos contaminated soil (OU-2). Remedial action for the contaminated ground water "hot spot" began in July 1999. Soil vapor extraction is the chosen remedy. The remediation pilot study for the leading edge of the ground water contamination is in operation. The remediation consists of two vertical circulation treatment wells.

- Barry M. Goldwater Range – The Barry M. Goldwater Range is a 2.7 million acre military training area in southwestern Arizona. The range has been used continuously from the 1940s to the present for military ground warfare training, aerial target practice and ground strafing. Waste and spent munitions can be found at numerous sites within the boundaries of the range. The range is under the overall management of the United States Air Force, but is divided into two management units for the Air Force and the Marine Corps. One portion (about 30% of the range) is managed by the US Fish and Wildlife Service as the Cabeza Prieta National Wildlife Refuge.

  An Installation Restoration Program by Luke Air Force Base in 1992 identified 218 possible areas of concern. Of these sites, 130 required no further action and were closed, leaving 88 areas. Forty-five of the 88 areas are active operations and are managed under state and federal Resource Conservation and Recovery Act regulations. Of the other 43 sites, additional investigations have been completed at 12 sites (two areas at the Gila Bend Auxiliary Air Field and ten sites dispersed at the former Ajo Air Station, Sentinel Navy antenna site, and various locations within the range).

  Currently, only the Ajo sites remain unresolved. Although two cleanups were performed by the Air Force at this site, small pockets of chlordane still exist at the site. ADEQ staff met with USF&WS and Luke Air Force Base on February 7, 2001 to discuss the closing out of the Ajo site. An agreement was reached between the parties on closing out the site which required some additional work by the Air Force Base. The Air Force Base is currently awaiting funding to enable them to proceed.

- Yuma Army Proving Grounds – The US Army Yuma Proving Grounds occupies 870,000 acres on the California-Arizona border north of Yuma. Its western edge is adjacent to the Colorado River. Yuma Proving Grounds was first used by the military in 1942 for training desert troops. Since that time, its mission has added testing and evaluation of a variety of military equipment including: boats, vehicles, well drilling equipment, tanks, and munitions.

  The U.S. Army has identified 19 sites where soil and ground waters samples need to be collected and analyzed to determine the nature and extent of risks posed by contaminants. The contaminants of concern include petroleum hydrocarbons, volatile and semi-volatile organic compounds, and metals. The sites were organized into four operable units based on their proximity to the main post and opportunities for rapid cleanup or similarity for cleanup.

  For some sites, data are sufficient to indicate that a remedial response is warranted. Studies are already underway at these sites to determine the appropriate response strategy. The Fuel Bladder Test Area was designated for immediate investigation by the base due to the determination that fuel in the amount of approximately 500,000 gallons may have been released at the site between 1965 and 1975. Analyses of ground water samples from monitoring wells installed during ongoing investigation of the site have shown evidence of petroleum and petroleum by-products. The effectiveness of soil vapor extraction technology was studied in 2000. At another site, the Former Waste Disposal Area, a fence to limit access to the site is being considered as an interim remedial action and an institutional control of the site.

  Reports for the remedial investigation sampling and analysis plan, for selected sites, as well as the quality assurance project plan for the Yuma

Proving Ground site have been reviewed and approved by ADEQ. Initial field sampling, at some sites, has been completed. Monitoring wells are planned for the Fuel Bladder Test Area and the Former Waste Disposal Area.

Ground Water Reconnaissance Survey in Mohave County: The watersheds (Sacramento Valley, Big Sandy Valley, Detrital Valley and Hualapai Valley) are all to the south of the Colorado River – (See discussion in the Colorado Grand Canyon Watershed.)

Watershed Partnerships

Lower Colorado River Citizens Advisory Council – This advisory group primary focus is Lake Havasu pollution, including potential impacts from litter, gasoline and MTBE, septic systems, and ground water protection. The new council is developing a Watershed-based Plan, identifying new partners, and working to obtain a watershed pilot grant.